

DRAFT -- GRAND ALLIANCE CONFIDENTIAL

1. INTEROPERABILITY

A successful HDTV standard will be used for HDTV delivery to the public by terrestrial broadcasting and a variety of alternate media, and it will also form the basis for new services and new applications of HDTV across a wide range of industries. In order for the enormous potential impact of digital HDTV to be realized, a high degree of interoperability is an essential attribute of an American standard.

2.1 INTEROPERABILITY INTRODUCTION

The formation of the Grand Alliance moves the HDTV standardization process from a competitive phase into a new collaborative phase. The previous competitive phase stimulated the rapid development of technology, as well as broad industry debate over various attributes in which the proposed systems differed. In the new collaborative phase, the Grand Alliance and the Advisory Committee must rapidly establish a national consensus and move forward into laboratory and field performance verification, and the documentation of a standard for FCC approval. Failure to achieve these objectives can only result in damage to every industry that is potentially advantaged by the deployment of HDTV systems and technology.

Because HDTV will have an important impact on many industries, there are many concerns about interoperability from a diverse collection of potential users. These concerns impact virtually every aspect of the HDTV system. Those aspects of HDTV that concern different interests sometimes create conflicting desires for interoperability with established systems and/or practices in different industries that cannot be satisfied simultaneously. It must be understood that interoperability among systems does not require them to be identical. Interoperability is defined as: The capability of providing useful and cost-effective interchange of electronic image, audio and associated data: among different signal formats, among different transmission media, among different applications, among different industries, among different performance levels. This means that systems can be made to interoperate across an appropriate interface. In this context, interoperability cannot be viewed as a binary characteristic that simply exists or does not exist. The degree of a system's interoperability must be evaluated in a complex multidimensional space that considers the established standards and practices of various industries, as well as the technical feasibility and cost impact of providing interfaces at different operational boundaries between applications or industries.

In some cases where the Grand Alliance confronted the dilemma of conflicting interoperability demands, it was technically feasible and reasonably cost-effective to allow a multiplicity of modes within the system. In these cases, the presence of modes favored by a particular industry do not

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preclude the inclusion of modes that are more favorably viewed by a different industry. The result is a system that is maximally useful to all industries, rather than one that burdens one industry and not another.

In other cases where the Grand Alliance confronted the dilemma of conflicting interoperability demands, a choice had to be made among the conflicting alternatives. In these cases, there are good technical reasons for the choice that was made, and careful consideration has been given to interface requirements that bridge the differences between the approaches of different industries and make the system interoperable.

The purpose of this document is to:

1. discuss the interoperability aspects of the Grand Alliance HDTV system,
2. to identify areas in which conflicting interoperability desires occur,
3. to explain the technical rationale behind our solution, and
4. to describe the resulting interoperability

2.2 INTEROPERABILITY CHOICES

At the picture layer, the Grand Alliance HDTV system is faced with a wide variety of conflicting interoperability requirements. Since the input to the HDTV transmission standard is a production standard, it is desirable for these two standards to be simply related. However, HDTV production standards are established with different international considerations as a high priority. Economical conversion between NTSC and HDTV sources is highly desirable in a simulcast environment where program sources will co-exist for an extended period of time. Likewise, consumer electronics manufacturers will have to produce dual standard HDTV/NTSC products, which also calls for special relationships between HDTV and NTSC formats. A great deal of television programming is originated on film, which calls for provision for the associated 24 Hz frame rate.

Computer graphics material generated for HDTV, and the ability to import HDTV pictures into multimedia computers, is greatly enhanced by progressive scan formats that have square pixels. Conversely, camera performance and sensitivity are significantly advantaged by interlaced scan formats. Economical recording is advantaged by minimizing the required pixels/sec, which favors interlaced scanning.

In addition to the conflicting desires listed above, the HDTV formats are constrained by the picture quality that can be delivered after compression to the approximately 18 Mbps that can be provided by the 6 MHz simulcast channel allocated by the FCC. The reality of the situation is that there are merits to high spatial resolution, high frame rate, and progressive scanning. However,

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these attributes cannot be simultaneously provided within the simulcast channel. Therefore, compromises of spatial and/or temporal resolution are necessary in a practical transmission system. Since there are picture materials that will cause visible artifacts for each compromised aspect of a system, there is no single format that has been able to achieve a national inter-industry consensus.

NEW FILE REPORT

:NBC-TV NEW YORK

(AUG 30 '93 10:41AM)

FILE NO.	FILE TYPE	DEPT. CODE	PAGES	GROUP	REMOTE TERMINAL IDENTIFICATION
07	SEND IMMEDIATE		9		917162536284
					914089743548
					916174895917
					919148926799
					916135924398
					912028283131
					913039399189
					919089496689
					916097342124
					912012850679
					99753646
					912024297849

REMAINING CALL CAPACITY 288

NOV 29 1993

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

ACATS Joint Experts Group on Interoperability (JEGI)

Minutes - Teleconference Call, Friday, 27 August 1993 (Revised)

All members of the Experts Group and the identified Grand Alliance representatives participated in the teleconference call which was called to order at 15:06 hrs:

ACATS Joint Experts Group on Interoperability	
R.Sanderson (Chair)	Eastman-Kodak
M.Liebhold (Vice-Chair)	Apple
S.Baron (Sec.)	NBC
B.Gerovac	Digital
M.Haley	IBM
P.Hearty	ATEL
R.Hopkins	ATSC
C.Tanner	CableLabs

Grand Alliance Representatives	
R.Keeler	AT&T
G.Reitmeier	DSRC

The stated objective of the teleconference call was to:
define the outline for a report (verbal and written) from the GA on "interoperability of the GA system ... response to the ACATS PS/WP4 interoperability study and recommendations."

with the agenda to be as follows:

1. Definition of Interoperability.
2. Outline for GA Interoperability Report.
3. Invite letter for October 6/7 Meeting.
4. Meeting locations for September 20 & October 6/7 Meetings.
5. Additions to Joint Expert Group on Interoperability.

1. Definition of Interoperability.

The Expert Group accepted as its definition of Interoperability, that definition adopted by PS/WP4:

"The capability of providing useful and cost-effective interchange of electronic image, audio and associated data; among different data formats, among different transmission media, among different applications, among different industries, among different performance levels."

The question was raised as to whether the Experts Group was to deal with Interoperability applied only within the transmission channel or did the charter

include dealing with Interoperability "up and down" the chain. It was agreed that our concern dealt with the latter with the understanding that the primary focus was on the FCC transmission standard for ATV broadcasting.

2. Outline for GA Interoperability Report

G.Reitmeier presented a draft Outline for the Grand Alliance Interoperability Report. (See attached.)

- The following suggestions for improvement were adopted:

- * Adding a section on "Migration";
- * Adding, early in the report, an overall summary of the Grand Alliance response to the PS/WP4 list of critical parameters (i.e. progressive scan within the transmission channel, square pixels, etc.);
- * Address interoperability examples for specific applications; and
- * Address the issue of the National Information Infrastructure (NII).

G.Reitmeier will update GA Outline to include these items.

- R.Hopkins raised a question on how a practical interface between devices would be implemented. The concept of a simple, practical hardware interface and employment of Headers as a service identification mechanism was discussed.

This led to a discussion on identifying the family of standards that must be developed beyond those that might be adopted by the FCC. R.Hopkins informed the group that the ATSC has prepared documents addressing these issues. Hopkins agreed to distribute the documents to the participants on this teleconference.

3. Invite letter for October 6/7 Meeting.

- It was agreed that we should be seeking input from industries and communities affected by the FCC's standardization of ATV.

- It was further agreed that the members of the Experts Panel would be asked to prepare presentations on requirements deemed important by the industries or communities that represented. The presentations are to focus on technical requirements (i.e. picture resolution, latency, formats, etc.) to aid the Grand Alliance in selection of the system parameters.

B.Gerovac and M.Liebhold agreed to prepare a guide for use by the Experts Panel as a framework within the context of the Grand Alliance proposal. The following schedule was adopted:

03 Sep: Draft document by Gerovac and Liebhold to this meeting's participants for comment.

08 Sep: Response by participants to draft document.

10 Sep: Final document forwarded to Experts Panel invitees as a followup to the letter of invitation.

- It was resolved that the letter of invitation should inform the invitees that 1). the above mentioned guideline would be forthcoming; 2). the goal of the meeting was to solicit information that would be of assistance to the GA in designing their system; 3). they should be specific in presenting those technical changes they would ask to be made to provide additional "interoperability" for their applications; and 4). they should be prepared to discuss why those changes are warranted when they reduce the level of "interoperability" for another community of interest. The following schedule was agreed to:

30 Aug: letter of invitation redrafted by Sanderson and forwarded to this meeting's participants for comment.

31 Aug: Response by participants to draft document.

03 Sep: Final document forwarded to Experts Panel.

It was also resolved to modify the text of the agenda of the October 6/7 meeting so that the note about the 21 October date clearly indicated that this is the date for submitting a preliminary report and is not the date for a future Experts Panel meeting.

- There was a significant discussion on expanding the list of invitees to make sure that all industries and communities of interest have an opportunity to participate in the Experts Panel discussion. This view was strongly supported by the Grand Alliance representatives. This led to a discussion on whether there needed to be a balanced representation within each community (i.e. all four networks ABC, CBS, NBC, and PBS, all major computer companies, all major cable MSOs, etc.). It was also recognized that the meeting would be open to the public and that interested parties would be able to attend whether they received a formal invitation or not. R.Sanderson agreed to study this issue.

- It was further resolved that the meeting would be extended to two days (October 6: 10:00 - 17:00 and October 7: 08:00 - 17:00)

4. Meeting locations for September 20 & October 6/7 Meetings.

- It was agreed that the September 20 meeting would be held at Kodak in Rosslyn, VA.

- There was no final selection of a site for the 6/7 October meeting. The site must be capable of accommodating 70 people. The NAB was suggested as a possible site.

5. Additions to Joint Expert Group on Interoperability.

- R.Sanderson suggested we consider expanding this Joint Experts Group on Interoperability by one or two individuals. The individuals suggested were:

1. Jules Bellisio (Bellcore), and
2. Tice DeYoung (ARPA/CSTO)

The teleconference was terminated at 17:33 hrs.

ACATS — JOINT EXPERTS GROUP ON INTEROPERABILITY

CC to:

R. Sanderson	Eastman Kodak	Chair
M. Liebhold	Apple	Vice Chair
S. Baron	NBC	Secretary
J. Bellisio	Bellcore	
M. Haley	IBM	
B. Gerovac	Digital	
R. Hopkins	ATSC	
C. Tanner	CableLabs	
T. DeYoung	ARPA/CSTO	
P. Hearty	ATEL	

Grand Alliance

R. Keeler	AT&T
G. Reitmeier	David Sarnoff

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**Advisory Committee on
Advanced Television (ATV) Service**

Doc. No. _____

Date _____

September 2, 1993

To: Interoperability Panel Members
Joint Experts Group on Interoperability

On behalf of the Technical Subgroup of the FCC Advisory Committee for Advanced Television (ACATS), we invite you to participate in an Interoperability Review of the Grand Alliance System Proposal.

As part of the final evaluation process for proposals for a new U.S. television format, the ACATS Technical Subgroup recently formed a Joint Experts Group on Interoperability to help evaluate the Grand Alliance proposal. In order to accomplish this important work we seek input from industries and communities (including, for example, the emerging National Information Infrastructure) that might be affected by the FCC ATV standardization. Specifically, we are soliciting inputs from experts representing various industries and communities, and in sufficient technical detail that those inputs can beneficially shape the Grand Alliance system definition. You are being invited to participate on an Interoperability Panel based on your demonstrated expertise in your field, and in the industry or public interest area you represent. (Please see the attached list of invitees.)

In order to conduct the planned review, gather input for the Grand Alliance and draw conclusions/recommendations, we would expect your participation in two meetings (preliminary details are provided below). The Joint Experts Group on Interoperability is currently working with the Grand Alliance to structure the review in which we are asking you to participate. Framework for the review will be the earlier interoperability study and recommendations by ACATS PS-WP/4 (we enclose copy of a report of that work for those of you that did not directly participate). Further, the Grand Alliance will prepare a formal response to the PS-WP/4 interoperability recommendations, detailing the consideration they have given to meeting interoperability recommendations as well as rationale for the trade-offs they have made where conflicting requirements have made that necessary. Ultimately, the Joint Experts Group will report conclusions and recommendations from the review, including and based on your expert opinion and judgment.

We can't be absolutely precise in predicting the amount of effort required to accomplish the review. However, with some appropriate structuring and advance work on our part and yours, we believe we can accomplish the work in two meetings of one to two day duration. Meetings will be held in Washington DC. Plans, as we currently envision them are as follows:

Interoperability Review Mtg #1 (location in Washington, DC to be announced)

October 6 (10:00AM - 5:00PM) & October 7 (8:00AM - 4:00PM)

Agenda:

- Review ACATS PS-WP/4 Interoperability Study & Recommendations
- Grand Alliance Interoperability Response
- Interoperability questions from Interoperability Panel
- Preliminary conclusions and recommendations (to be reported at the ACATS Technical Subgroup October 21 meeting)

November (date to be set)

Agenda:

- Final conclusions and recommendations

In order to accomplish our work with a minimum of formal meetings, we will expect to provide additional materials along the way for your review. These will likely include a system definition summary for the Grand Alliance proposal as well as draft of the Grand Alliance "Interoperability Response". By providing these materials before the review meeting, we would expect you to be able to provide more specific inputs to the review. In particular, we will be looking for specific technical suggestions that can guide the Grand Alliance design — what would you change in order to increase interoperability in the field of your expertise and interest? We will ask that your inputs be in document form as much as that is possible and framed in the context of the Grand Alliance system proposal.

Please confirm your willingness to participate in this important work and, if so, confirm your attendance at the October 6/7 meeting. We will provide more detailed requests, notices and expectations along the way. Meanwhile, we wanted to give early notice of the October 6/7 meeting, gain your commitment to participate in this important work and get the meeting on already busy calendars.

Cordially,

Robert L. Sanderson
Eastman Kodak Company
Chairman
(716-726-7763)

Michael Liebhold
Apple Computer, Inc.
Vice Chairman
(408-974-6025)

Joint Expert Group on Interoperability
Advisory Committee on Advanced Television Systems

Attachments:

Interoperability Panel List
Interoperability Definition
ACATS Joint Experts Group on Interoperability
ACATS System Recommendation (Executive Summary)
ACATS PS-WP/4 Final Report

INTEROPERABILITY DEFINITION

Reference: ACATS PS-WP/4 INTERIM REPORT December, 31, 1992

Definition: The cabability of providing useful and cost-effective interchange of electronic image, audio and associated data: among different signal formats, among different transmission media, among different applications, among different industries, among different performance levels.

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ACATS — JOINT EXPERTS GROUP ON INTEROPERABILITY

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M. Liebhold	Apple	Vice Chair
S. Baron	NBC	Secretary
J. Bellisio	Bellcore	
M. Haley	IBM	
B. Gerovac	Digital	
R. Hopkins	ATSC	
C. Tanner	CableLabs	
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P. Hearty	ATEL	

Grand Alliance

R. Keeler	AT&T
G. Reitmeier	David Sarnoff

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**FACSIMILE MESSAGE FROM
 ROBERT SANDERSON, EKC
 PHONE: 716-726-7763 FAX: 716-253-6284**

September 13 1993

6 Pages Including This Cover

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Message

Interoperability View on 1080 vs. 960.

September 13, 1993

**To: R Keeler, AT&T
From: R Sanderson
Subject: Input on "Interoperability View on 1080 vs. 960"**

To date I have received only two responses from the Joint Experts Group on Interoperability on the request posed in my September 2, 1993 FAX on the subject matter (copy attached). For your information I am attaching those responses.

From my personal view I believe 1080 to be preferred for interoperability much for the same reasons cited by Stan Baron in his response --- square pixels, potential alignment with international and production standards, 1.5x relationship to 480 and 720 line count formats.

If additional responses are received I will relay them as I receive them, however, knowing that the Grand Alliance is committed to provide a proposed decision on this matter soon I did not want to delay an input from the Joint Experts Group.

Regards, Bob Sanderson.

cc: Joint Experts Group on Interoperability

**Image Telecommunications Center,
Eastman Kodak Co., 1447 St. Paul St., Rochester, N. Y. 14653-7102
(716) 726-7763 KMX 236-7763 FAX (716) 253-8264 rsanderson@kodak.COM**

September 2, 1993

**To: Joint Experts Group on Interoperability
From: R Sanderson
Subject: Interoperability View on 1080 vs. 960**

Robert Keeler has asked for input from the Joint Experts Group on Interoperability on the issue 1080 versus 960.

As I believe you know, the Grand Alliance is currently working to resolve their position on the matter of deciding the line count for the high (~1000 line) line-count scanning format. The Grand Alliance proposed 960. Meanwhile, the ACATS Technical Subgroup has recommended that the GA adapt 1080 instead, for reasons that have been documented in minutes of the Subgroup meetings. The GA is currently working against a commitment of responding to the Technical Subgroup on this issue by September 14, 1993. Consistent with this commitment, Mr. Keeler, on behalf of the GA, is seeking input on this matter and with respect to the issue of interoperability. Keeler recognizes that further input and views may surface in the interoperability review anticipated on October 6/7, however, asks if the Joint Experts Group could provide at least initial input at this time.

With respect to this matter:

- 1. Find attached a paper setting forth considerations on this matter by the Grand Alliance --- you may find this of interest in formulating your response.**
- 2. Please provide your views on this matter by return FAX to me and I will summarize and forward them to Keeler for the GA.**

In responding to this request I would ask that you consider one of three responses:

- Interoperability is not affected by the choice of 1080 vs. 960**
- 960 is preferred for interoperability for the following reason(s)**
- 1080 is preferred for interoperability for the following reason(s).**

Please provide your response by September 9, 1993.

**Robert L. Sanderson
Chairman, Joint Experts Group on Interoperability**

cc: J Flaherty

SENT BY:BOULDER, COLORADO

: 9- 8-93 :12:34PM :

CABLELABS-

716 253 6284:# 2/ 2

CableLabs

Cable Television Laboratories, Inc.

Craig K. Tanner
Vice President
Advanced Television Projects

Dr. Robert Sanderson
Manager, Telecommunications Lab
Eastman Kodak
Building 12-A, 3rd Floor
Hawkeye Plant
1447 St. Paul Street
Rochester, NY 14653-7017

Dear Dr. Sanderson:

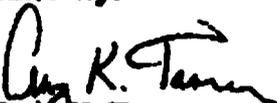
September 8, 1993

This letter is in response to your fax dated August 27, 1993, asking for reaction to Bob Keeler's request for comment on the Draft Grand Alliance document entitled "Scanning Formats for Grand Alliance HDTV."

In the document's repeated references to the 1,080-line format and the difficulties it causes in terms of total information rate, it is nearly always coupled to a horizontal pixel count of 1,920. My memory of the Technical Sub-Group's recommendation was that 1,440 be considered as the horizontal pixel count for the broadcast/cable ATV signal, with 1,920 to be reserved for the studio signal. Thus, the penalty is much smaller than is characterized in the Grand Alliance document in sections B1, B2, C2, C3, E1, F1, and G3.

I would hope to see another analysis from the Grand Alliance that addresses the differences between 1,440 x 1,080 and 1,728 (or 1408) x 960.

Sincerely,


Craig K. Tanner

cc: R. Hopkins, ATSC
B. James, CableLabs
R. Prodan, CableLabs

212 664 5219

SEP 13 '93 09:18AM NBC-TV NEW YORK

P.1



NBC TECHNOLOGY

SEP 13 1993

TELEFAX MESSAGE

Number of pages including this one: 2

TO: Robert Sanderson
FM: S.N. Baron
Phone: +1-212-664-7657
Fax: +1-212-664-5219
DT: 09 Sep 93
RE: Interoperability on the issue of 1080 versus 960

I am responding to your Telefax Message requesting input on interoperability with respect to 1080 line or 960 line systems.

Of the three responses offered for consideration,

"1080 is preferred for interoperability for the following reasons"

best represents my point of view.

The reasons are as follows:

1. **Square Pixels:** Square pixels have been identified as desirable for interoperability. The 1080 line system is based on a 1080(V)x1920(H) production pixel matrix which is a geometrically square structure in a 16:9 picture aspect ratio environment. The 960 line system is based on a 960(V)x1728(H) production pixel matrix which is not a geometrically square structure in a 16:9 picture aspect ratio environment. The latter differs from a square pixel by 1.25%. If the computer industry can accept that difference as an acceptable tolerance on a square pixel then the 960 line system would meet the square pixel relationship.

2. **International standards:** The 1080x1920 format does not violate any of the agreements reached to date in formulating CCIR Recommendation 709. Included in this set of agreements is the horizontal active pixel count per line of 1920. The 960x1728 set does not conform to Recommendation 601. There is some hope that agreement could be reached on an international CIF (Common Image Format) structure based on an active pixel area of 1080x1920. There is no basis on which an agreement could be reached on a 960 line system. 1080-lines satisfies the desire by the international community for 1000 or more lines. It is my understanding that the Japanese Administration has indicated that a 1080 line system could form the basis of an international standard and that a 960 line system could not. It is my further understanding that the European Community

-2-

has indicated that a 1080 line system as the basis of an international standard is under study but that a 960 line system could not form the basis of an agreement.

3. Filtering: Conversion of pixel maps from one structure to another are achieved by digital filters. Current accepted practice suggests that the best results for conversions occurs when the scaling relationships (and, therefore, the sampling frequencies) are separated by a factor of 1.5 or greater. Simple integer relationships also assist in the design of economical filters as they limit the number of coefficients necessary to construct the filter. Similar filters would be necessary to generate lower resolution images within a single image structure for use in window or pbx-in-pbx environments.

Note: 480 (number of active lines in 525-line system) $\times 1.5$ ($3/2$) = 720
 $720 \times 1.5 = 1080$

$$480 \times 2 = 960$$

$$720 \times 1.3333\dots(4/3) = 960$$

4. System resolution: Expected advances in compression efficiency may permit the implementation of a 1080-line system in 6 MHz. Current technology can support a subsampled version of the 1080-line system in a 6 MHz channel. A compromise of an interim standard with lower resolution (subsampled) is easier to upgrade than trying later to increase the number of lines.



ACATS- Joint Experts Group on Interoperability
FACSIMILE MESSAGE FROM
ROBERT SANDERSON, EKC
PHONE: 716-726-7763 FAX: 716-253-6284

September 14, 1993

1 Pages Including This Cover

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Message

For Your Information we have added Jules Bellisio and Tice DeYoung to the ACATS Joint Experts Group On Interoperability. Their particulars are as follows:

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OFFICE OF THE SECRETARY

**ACATS PLANNING SUBCOMITTEE - WORKING
PARTY 4
FINAL REPORT
INTEROPERABILITY ASSESSMENTS**

PS-WP/4 FINAL REPORT

EXECUTIVE SUMMARY

The objective of Planning Subcommittee Working Party 4 (PS-WP/4) was to study and make recommendations regarding the relationship of terrestrial advanced television systems to alternative media, applications and standards. It was also the objective to investigate approaches for growth paths to the future while, at the same time, to support timely decisions on an advanced television (ATV) broadcast system with increased performance quality for the end user. Participants of Working Party 4 have addressed issues related to interoperability, scalability and extensibility and more generally, openness. Representatives of the broadcast television, cable television, program production, motion picture, computer, telecommunications, and imaging industries were active in this working party.

In the prior year's effort (1991), PS-WP/4 developed definitions of key terms such as interoperability, scalability and extensibility. Based upon a world becoming more complex and richer in alternatives (media, transmission/distribution, presentations), the working party developed the concept of image data, defined as the digital equivalent of the video information including image, sound and auxiliary data components. As a result, PS-WP/4 recommended the following in its December 1991 Interim Report:

- Maximize utilization of digital video techniques and image data representation.
- Apply HEADERS and DESCRIPTORS (as agreed by industry standards groups) as a method of identifying image data.

Once the Systems Subcommittee Working Party 4 (SS-WP/4) established the ten selection criteria, PS-WP/4 adjusted its focus to concentrate on the three criteria that related to alternative media: Interoperability, Scope of Services and Features, and Extensibility.

An assessment of the five proponent systems in reference to the above three criteria was made by PS-WP/4. PS-WP/4 developed an OSI-like layered architectural model for ATV to aid in evaluating the proponent systems along with applications and performance questions on these criteria. PS-WP/4 employed a technical consultant, StellaCom, Inc., to assist in this analysis. The assessments were based upon information supplied by each of the proponents in (1) published form, (2) response to specific PS-WP/4 questions and (3) a three-day Interoperability review involving the proponents and a Special Interoperability Review Board (convened specifically for evaluation of the proponent systems relative to the three criteria and conducted in September 1992). The Review Board consisted of experts across a broad array of relevant disciplines. The selected experts had no relationship to any of the system proponents. Results of the Review Board evaluation weighed heavily in the PS-WP/4 conclusions and recommendations.